



# Microbiological risks of the consumption of raw milk and raw milk dairy products

***Verraes C.<sup>1</sup>, Claey s W.<sup>1</sup>, Cardoen S.<sup>1</sup>, Vlaemynck G.<sup>2</sup>, De Zutter L.<sup>3,7</sup>, Daube G.<sup>4,7</sup>, Sindic M.<sup>4,7</sup>, Uyttendaele M.<sup>3,7</sup>, Dierick K.<sup>5,7</sup>, Imberechts H.<sup>6,7</sup>, Herman L.<sup>2,7</sup>***

<sup>1</sup> Federal Agency for the Safety of the Food Chain (FASFC) - Belgium; <sup>2</sup> Institute for Agricultural and Fisheries Research (ILVO) - Belgium; <sup>3</sup> Ghent University - Belgium; <sup>4</sup> University of Liège - Belgium; <sup>5</sup> Scientific Institute of Public Health (WIV-ISP) - Belgium; <sup>6</sup> Veterinary and Agrochemical Research Centre (CODA-CERVA) - Belgium; <sup>7</sup> Scientific Committee of the FASFC - Belgium  
Corresponding author: [claire.verraes@favv.be](mailto:claire.verraes@favv.be)

## Introduction

**Objective:** to evaluate the microbiological risks of the consumption of raw cow milk (Advice SciCom 15-2011, Claey s *et al.*, 2013), of raw milk from animal species other than cows (Advice SciCom 11-2013, Verraes *et al.*, 2014) and of dairy products made from raw milk (Advice SciCom 02-2015, Verraes *et al.*, 2015).

• The scope includes raw milk from cows, sheep, goats, horses, donkeys, camels, llamas, buffaloes, yaks and reindeer and cheese, butter, cream and buttermilk made from raw milk from cows, sheep, goats and buffaloes. Only zoonotic microorganisms and microorganisms from the environment are taken into consideration.



## Material and Methods

• The risk evaluation is based on an elaborate literature study and expert opinion provided by the Scientific Committee of the FASFC as well as external experts.

## Results

### Pathogenic microorganisms possibly present in raw milk and sources of contamination

	Blood	Mas- titis	Faeces /skin	Environ- ment
Salmonella	(X)	(X)	X	X
Brucella spp.	X	(X)		X
Mycobacterium bovis	X		X	X
Coxiella burnetii	X		X	X
Mycobacterium avium subsp. paratuberculosis (MAP)	X		X	X
Listeria monocytogenes	X	X	X	X
Human pathogenic verotoxin-producing E. coli (VTEC)			X	X
Campylobacter jejuni and coli			X	X
Corynebacterium pseudotuberculosis	(X)	(X)		
Human pathogenic Yersinia		X	X	X
Bacillus spp.				X
Enterotoxin-producing Staphylococcus aureus	X	X	X	X
Arcanobacter pyogenes		X		
Streptococcus spp.		X	X	X
Leptospira	X			X
Rift Valley Fever virus	X			
Tickborne encephalitis virus (TBEV)	X			
Cryptosporidium parvum			X	X
Clostridium botulinum toxins	X		X	X
Helicobacter pylori			X	X
Toxoplasma gondii	X		X	X

Based on expert opinion, a list was established of pathogenic microorganisms than can be present in raw milk. A distinction can be made between an endogenous infection, in which the milk is contaminated by direct transfer from the blood stream (systemic infection) or from an udder infection (mastitis), and a cross-contamination, in which the milk is contaminated by faeces, the skin or the environment (external contamination during or after milking).

### Frequencies of occurrence of pathogenic microorganisms in raw milk and raw milk dairy products (minimum frequency – maximum frequency in %)

	Cow milk	Goat milk	Sheep milk	Horse milk	Donkey milk	Camel milk	Buffalo milk	Yak milk	Cheese	Butter	Cream
Salmonella	0-2.9	0	0-5	0	0	9.5	0	/	0-4.3	0	0
VTEC	0-5.7	0-16.3	0-12.7	0	/	/	0-1.4	0.22.2	0-55.3	0-10	0
L. monocytogenes	2.2-10.2	0-7.8	0-3.3	0	/	/	0-25	/	0-42.0	0.2-29.9	0-8.3
Campylobacter	0-6	0	0-2.2	0	/	/	0	/	0	0	/
S. aureus	/	1-96.2	21-100	13	0-5	8.8-28.6	0-83.3	/	0-100	1.6-24.7	/
B. cereus	/	29.9	29	/	/	/	/	/	0-28	/	/
MAP	/	0-23	0-23.8	/	/	/	0-21.7	/	0-20	/	/
C. burnetii	/	1.8-4.5	0-5.7	/	/	1.4	/	/	57	0	50
Streptococcus	/	0.6-4.1	23-100	/	1-2	9.5	/	/	/	/	/
H. pylori	/	8.7-25.6	0-60.3	/	/	/	3.6	23.4	/	/	/
TBEV	/	20.7	22.2	/	/	/	/	/	/	/	/

Detection frequencies of human pathogenic microorganisms in raw milk and raw dairy products are described, based on a scientific literature search in Europe. It should be noted that these detection frequencies can vary according to the sampling and methodological approach. Variation can also be explained by geographical differences, the season in which the samples were taken, the size of the farm, the density of the animal population, regional differences in the keeping and taking care of animals, etc.



### Worst case behavior of pathogenic microorganisms in different types of raw milk cheeses

	Hard cheese Production	Storage	Semi hard cheese Production	Storage	Soft cheese Production	Storage
Salmonella	Survival	Survival	Growth	Survival	/	/
VTEC	Growth	Survival	Growth	Survival	Growth	Survival
L. monocytogenes	Survival	Survival	Growth	Survival	Growth	Growth
Campylobacter	No survival	/	No survival	/	/	/
S. aureus	Survival	No survival	Growth	Growth	/	

The worst case behavior of the most relevant pathogenic microorganisms was estimated based on an international scientific literature search as well as on expert opinion.

### Number of outbreaks linked to raw milk and raw milk dairy products

	Cow milk	Goat milk	Camel milk	Cheese	Cream
Salmonella	39	0	0	22	0
VTEC	28	6	0	17	1
L. monocytogenes	2	0	0	8	0
Campylobacter	39	6	0	5	0
S. aureus	/	1	0	4	0
Brucella	/	3	4	7	0
Streptococcus	5	0	0	1	0
TBEV	1	6	0	1	0
T. gondii	/	3	0	0	0
Corynebacterium	2	0	0	0	0
A. pyogenes	3	0	0	0	0

Based on international scientific literature as well as on other reliable data sources worldwide, a list of reported human cases and outbreaks due to the consumption of raw milk and raw dairy products was established. Outbreaks were found for raw milk from cows, goats and camels, but not for raw milk from other animal species. Outbreaks were also found for cheese and cream made from raw milk, but not for raw milk butter or raw buttermilk.

## Discussion and conclusions

- The main microbiological risks related to the consumption of raw cow, sheep and goat milk in Belgium are *Campylobacter*, *Salmonella* and VTEC. Raw donkey and horse milk generally has a high microbial quality. In other European countries, additional microbiological risks are TBEV in raw goat milk and *Brucella* spp. in raw camel milk.
- The microbiological hazards of raw milk dairy products in Belgium are mainly linked to *Listeria monocytogenes*, VTEC, *Staphylococcus aureus*, *Salmonella* and *Campylobacter*. The risks are higher for cheeses, especially (semi) soft cheeses without acidification, and lower for butter and cream. Research showed that in butter there is a reduced growth potential of most pathogens such as *Listeria monocytogenes*. In endemic areas in Belgium or in other European countries, raw dairy products may also be contaminated with *Brucella* spp., *Mycobacterium bovis* or the TBEV.
- Heat treatment of milk before consumption and before manufacturing of dairy products is important to ensure the food safety.

For further information please visit <http://www.favv-afsca.fgov.be/scientificcommittee/> > Opinions

References: Claey s, W. L., Cardoen, S., Daube, G., De Block, J., Dewettinck, K., Dierick, K., De Zutter, L., Huyghebaert, A., Imberechts, H., Thiange, P., Vandenplas, Y., Herman, L., 2013. Raw or heated cow milk consumption: Review of risks and benefits. Food Control 31, 251-262. Verraes, C., Claey s, W., Cardoen, S., Daube, G., De Zutter, L., Imberechts, H., Dierick, K., Herman, L., 2014. A review of the microbiological hazards of raw milk from animal species other than cows. International Dairy Journal 39, 121-130. Verraes, C., Vlaemynck, G., Van Weyenberg, S., De Zutter, Daube, G., Sindic, M., Uyttendaele, M., Herman, L., 2015. A review of the microbiological hazards of dairy products made from raw milk. International Dairy Journal, in press.